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of Class Oe,—namely, A. G. C. 9311. As in the latter, Hβ is not so strong as Hγ and Hδ. Slight brightening is present on the red edge of Hγ′, 4542.1 A, and He 4471 A, but it is presumably not as conspicuous as in A. G. C. 9311 and A. G. C. 22843, respectively. The bands 4634.7 A, 4641.8 A, and 4686.3 A are each about 3.5 angstroms in width. The first two are equally intense and somewhat stronger than 4686.3 A. The two dark lines at 4089 A and 4096 A have recently been ascribed by Miss CANNON to argon.

The distinctive features of this star's spectrum are the several bright lines or bands which are characteristic of the Wolf-Rayet stars, the numerous wide dark lines which are characteristic of the *Orion* type stars, and the bright borders of the hydrogen and helium lines which are characteristic of the bright-line stars of Classes B to A. These features aid in establishing the connection of the Wolf-Rayet with the early type stars, a connection quite certain but not fully understood.

G. F. PADDOCK.

September, 1914.

RELATION OF THE MOUNT WILSON PHOTOGRAPHIC AND PHOTOVISUAL MAGNITUDE SCALES.

With the aid of an objective-grating attached to the 60-inch reflector, HERTZSPRUNG has determined the effective wave-lengths of about two hundred stars in the cluster N. G. C. 1647. He has also provided data by means of which the color indices of the individual stars may be calculated from their respective effective wave-lengths.

Since color index is by definition the difference between photographic and visual (or photovisual) magnitude, it follows that a comparison of color indices derived from magnitudes with those calculated from effective wave-lengths affords a control upon the mutual relation of the photographic and visual magnitude scales. The test is the more important in that it can be applied to relatively faint stars. There is no particular difficulty in establishing the two scales so that, in accordance with international convention, they coincide at the sixth magnitude for stars of spectrum A0. But when this has been accomplished, it is difficult to find assurance that they stand in the proper relation to each other in the region of the fainter magnitudes. Any divergence, unless affecting both scales equally, must disturb this relation. As such divergences are notoriously difficult of detection, the suggested comparison of color indices seems important.

The test has been applied to the region investigated by HERTZSPRUNG by comparing the cluster with the Pole, for which both the photographic and photovisual magnitudes have been determined on an absolute scale. For the photographic scale ordinary plates were used; for the photovisual, isochromatic plates exposed behind a yellow filter, the instrument being the 60-inch reflector.

Inasmuch as any error in the zero point of the magnitudes for the cluster enters undiminished into the color indices, special precautions were taken. Only nights of first quality were used; observations were made, as nearly as possible, when the cluster was at the altitude of the Pole; the exposures were short, not exceeding five minutes; the multiple exposures always began and ended with the same field, so that the order was: cluster, Pole, Pole, cluster, or the inverse; and, finally, the number of comparisons was five for each scale, made upon five separate nights.

Each plate gave a series of magnitudes, photographic or photovisual, for the stars of the cluster based upon the Mount Wilson magnitudes for the polar stars. The means for the five series for each scale were adopted for the calculation of the color indices. The zero point deviations of the separate plates from the means for the five are:—

Photographic	+0.04	—0.04	—0.14	+0.14	—0.04	magnitude
Photovisual	+0.06	+0.01	—0.09	+0.03	—0.08	“

The indicated probable error in the zero points of the two scales is therefore ± 0.03 magnitude, so that the uncertainty in the color indices arising from this source is ± 0.04 magnitude.

Aside from this error, there is also to be considered that due to differences in slope between the adopted scale for the cluster and those of the Pole. The latter is, however, very small, as experience shows that the mean of five such comparisons reproduces the original scale with a high degree of precision.

We may consider, therefore, that the polar scales have been transferred to the cluster with negligible errors in slope and with uncertainties in the zero points of the order of 0.03 magnitude.

For the comparison with HERTZSPRUNG's results only stars within the magnitude interval 11 to 14 were used. The magnitudes for objects brighter than 11, and the effective wave-lengths for those fainter than 14, are of low weight and unreliable. This restriction, and the limitation of the field, leaves available for the comparison 52 stars.

The color indices derived from the magnitudes show the same systematic change in the minimum index with increasing magnitude that was found by HERTZSPRUNG to characterize the effective wave-lengths—that is, the whitest objects among the faint stars are relatively red. The rate of increase in the color is slightly different in the two cases, but systematic differences between such different methods of measuring the effect are to be anticipated. This fact cannot, however, influence in any sensible degree the main result, which is as follows:

Mean C. I. 52 stars, magnitudes 11-14:
  From Mount Wilson magnitudes = + 0.47 magnitude.
  From HERTZSPRUNG's effective wave-lengths = + 0.46 magnitude.

It is to be remarked that the zero points of the Mount Wilson scales for the polar stars are still subject to corrections of a few hundredths of a magnitude. It is unlikely, however, that all sources of error combined render the mean color index from the magnitudes uncertain by as much as a tenth of a magnitude.

The inference, therefore, is that for a mean magnitude which may be taken as 12.5, the Mount Wilson photographic and photovisual magnitudes are in substantially the correct relation to each other. From this it follows that if either scale deviates appreciably from the true absolute scale, the other must be affected by a similar divergence.

F. H. SEARES.

MT. WILSON SOLAR OBSERVATORY, August 18, 1914.